

Two new species of the genus *Gymnodamaeus* (Acari: Oribatida: Gymnodamaeidae) from Tyrol (Austria), with remarks on diversity and distribution of the known species

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Two new species of the genus *Gymnodamaeus* (Acari: Oribatida: Gymnodamaeidae) from Tyrol (Austria), with remarks on diversity and distribution of the known species. - Two new species of oribatid mites, *Gymnodamaeus meyeri* sp. n. and *G. irregularis* sp. n., are described from Tyrol (Austria) in the Central Alps on the basis of adult and immature specimens. The diagnosis of *Gymnodamaeus*, diversity and distribution of the known species in different biogeographical regions are discussed.

Keywords: Gymnodamaeidea - Alps - description - systematics - biogeography.

INTRODUCTION

Gymnodamaeus Kulczynski, 1902 is the type genus of the Gymnodamaeidae Grandjean 1953 and is the genus with most species in this family. It was established by Kulczynski (1902) for two known species, *Damaeus bicostatus* C. L. Koch, 1835 and *D. femoratus* C. L. Koch, 1839, described by C. L. Koch (1835-1844). Later, the first taxon became the type species of *Gymnodamaeus*, and the latter species was transferred to the genus *Arthrodamaeus* Grandjean, 1954.

The genus *Gymnodamaeus* has been interpreted differently by various authors. In his early treatises of the classification of oribatid mites, Grandjean (1953) diagnosed this genus in a more comprehensive way, but subsequently separated it from other related genera, *Aleurodamaeus*, *Arthrodamaeus* and *Plesiodydamaeus*, erected by him (Grandjean, 1954).

Paschoal (1982, 1989) re-diagnosed the genus *Gymnodamaeus*, redefined the family Gymnodamaeidae, and established several new genera, such as *Adrodamaeus*, *Johnstonella*, *Nortonella*, *Odontodamaeus* etc., most of which resemble *Gymnodamaeus*.

In their identification key to the oribatid mite genera of the world, Balogh & Balogh (1992) followed Paschoal's classification, but at the same time Woas (1992) did not accept the system mentioned above and considered all genera erected by Paschoal (1989) as junior synonyms of *Gymnodamaeus*. Moreover, he combined several other

genera, such as *Jacotella* Banks, 1947, *Joshuella* Wallwork, 1972 and *Plesiodamaeus* Grandjean, 1954 with *Gymnodamaeus* and proposed a broader generic definition.

In the checklist of the oribatid mite species of the world, Subías (2004, 2008) accepted the validity of the genera *Jacotella*, *Joshuella*, *Nortonella* and *Plesiodamaeus*. However, in turn Subías declared another genus, *Pleodamaeus*, established by Paschoal (1982), as a junior synonym of *Gymnodamaeus* (together with *Johnstonella* and *Odontodamaeus*).

Weigmann (2006) mentioned the need of a thorough phylogenetic analysis to clarify the systematics of this family, and he viewed the family in a comprehensive way.

Thus, there are several different interpretations of this genus, and hence a fully acceptable generic definition is not available for *Gymnodamaeus*. In our opinion, the current supraspecific classification of Gymnodamaeidae is not well elaborated. Not only the generic diagnosis, but also most species of this family, especially those of *Gymnodamaeus*, are very poorly known. Due to their relatively simple structure and to the presence of a thick cerotegument covering the whole body that causes difficulties in observing important characters, the descriptions of most species are insufficient, and many species have even been described without illustration. Only the adults of a few species, e.g. *G. bicostatus* C. L. Koch, 1836, *G. helveticus* Woas, 1992, *G. mongolicus* (Bayartogtokh & Aoki, 1997) and some more, have been sufficiently described or redescribed, but the immature stages of all members of this genus are still unknown. Therefore, further detailed studies are necessary on type material of the poorly known species, as well as on their immature instars.

Since there is no fully acceptable definition for *Gymnodamaeus*, we here consider this genus in its broad sense. Both species described hereunder can be attributed to *Pleodamaeus* according to the strict definition by Paschoal (1982, 1989) and Paschoal & Johnston (1982), but we consider that as a junior synonym of *Gymnodamaeus* sensu lato.

The definition for adult specimens of *Gymnodamaeus* adopted here comprises the following combination of character states: Body and legs covered with thick cerotegument, without exuviae; articulation of leg segments not in sockets; posterior end of notogaster rounded or slightly undulated, without distinct prominent folds; three to five pairs of notogastral setae situated at posterior end of notogaster; epimeral region III with tubercle *Sp*; six or seven pairs of genital, two pairs of anal, and two or three pairs of adanal setae.

MATERIAL AND METHODS

The present work is part of an ongoing study on systematics, ecology and biogeography of oribatid mites in arid grasslands in Tyrol by one of us (H. S.). The descriptions of two new species presented in this work are based on adult and immature (deutonymph or tritonymph) specimens. Both species were collected in 2007, in the western part of Tyrol, in the Inn valley. Type locality and habitat characterization for each species are given in the paragraphs "material examined".

The morphological terminology used in this work is based mostly on that developed over many years by Grandjean (e.g. 1928, 1964), and for the cerotegumental ridge-like structures on the prodorsum the terminology of Paschoal (1982) is applied.

The body length was measured in lateral view, from the tip of the rostrum to the posterior edge of the ventral plate, to avoid discrepancies caused by different degrees of notogastral distension. The notogastral length was also measured in lateral aspect, from the anterior to the posterior edge; notogastral width refers to the maximum width in dorsal aspect, excluding cerotegumental extensions. The average measurement value is given in parentheses after the range.

The specimens were cleared in lactic acid and mounted on temporary slides. Ceroteguments on the body surface were removed using a 15.8% solution of *NaOCl* as proposed by Lions (1982). The specimens were placed in this liquid for up to five minutes and observed directly under the microscope. After the removal of the cerotegument the specimens were cleaned in water and alcohol.

DESCRIPTIONS OF SPECIES

Gymnodamaeus meyeri sp. n.

Figs 1-5

MATERIAL EXAMINED: Holotype (♀): Austria, Tyrol, Pfunds, steep forest of *Pinus sylvestris* above road to the hamlet Wand, 1060 m a.s.l., 25 April 2007, leg. H. Schatz; 12 paratypes (5♂ and 7♀) with same data as for holotype; eight paratypes (2♂ and 6♀), *ibid.*, in dry moss; two paratypes (1♂ and 1♀), *ibid.*, in grass and pine litter; tritonymphs (five specimens), same data as for adult holotype.

TYPE DEPOSITORY: The alcohol-preserved holotype and two paratypes will be deposited in the Muséum d'histoire naturelle, Genève, Switzerland, other specimens in the authors' collections.

DIAGNOSIS: Adults of this species are unique among the known species of *Gymnodamaeus* in the combination of the following character states: Medium in size; body, distal part of sensillus and legs covered with thick cerotegument consisting of round or conical granules; rostral seta inserted ventro-laterally; lamellar seta inserted dorso-laterally, slightly anterior to rostral seta; sensillus with long stalk, its distal part dilated, covered with dense cerotegument; postbothridial tubercle *Bp* well developed; prodorsum with a short, convex transversal ridge-like cuticular structure antero-medially of interlamellar setae; anterior part of prodorsum with a thin horseshoe-like structure; notogaster with blunt hexagonal ridge-like structures, the bands connecting them partially incomplete; five pairs of notogastral setae inserted on distinct tubercles and covered with cerotegument; six or seven pairs of genital and two pairs of adanal setae present; seta *ad*₁ absent; tectum of podocephalic fossa strongly developed.

DESCRIPTION OF ADULT

Measurements: Holotype: Body length 441 µm, length of notogaster 323 µm, width of notogaster 266 µm. Paratypes (n=11): Body length 395-441 (421) µm, length of notogaster 281-331 (310) µm, width of notogaster 224-251 (241) µm.

Integument: Body color yellowish brown. Surface of body, sensilli and leg segments covered with thick cerotegument consisting of round or conical granules. Exuvial scalps absent.

Prodorsum (Fig. 1A, E, F): Rostrum rounded in dorsal view, slightly projecting in lateral view. Rostral seta (*ro*) moderately long, covered with cerotegument, inserted ventro-laterally on prodorsum. Lamellar seta (*le*) also covered with cerotegument,

slightly shorter than *ro*, inserted dorso-laterally and slightly anterior to *ro*. Interlamellar seta (*in*) minute, but visible in dorsal view. Exobothridial seta (*ex*) slightly shorter than seta *le*, covered with cerotegument. Sensillus (*ss*) long, thin, its distal part dilated and covered with dense cerotegument. Sensillus bacilliform after removal of cerotegument (Fig. 1E). Bothridium (*bo*) irregularly funnel-shaped, with large openings. Postbothridial tubercle *Bp* well developed, visible in lateral view. Prodorsum with a short, convex transverse ridge-like cuticular structure (central ridge or *apo c* according to Paschoal, 1982) antero-medially of interlamellar setae; a pair of thin longitudinally meandering ridge-like structures (exobothridial ridges or *apo ex*) present antero-medially of each bothridium, leading in anterior direction and connected to a rostral ridge-like structure (*apo ro*) resembling a horseshoe; bothridial ridge-like structure (*apo bo*) well developed but short. Dorsal end of acetabular tectum I with distinct, posteriad-directed tooth (*It*), well visible in dorsal view (Fig. 1A).

Notogaster (Figs 1A, F, 2I): Oval, about 1.2 times as long as wide, very flat in lateral view and conspicuously flattened anteriorly; anterior notogastral margin broadly rounded. Surface with blunt hexagonal ridge-like structures formed by a pair of waved bands running along longitudinal axis of notogaster and connected by transversal bands forming intra-marginal depressions; anterior ends of longitudinal bands connected to each other near anterior notogastral margin, posterior ends reaching posterior margin of notogaster and continuing separately; one pair of short antero-lateral bands present behind anterior margin of notogaster, and two pairs of median, laterally (transversally) branched bands present midway between anterior and posterior margins of notogaster; outer margin of notogaster also framed by ridge-like structures. Five pairs of notogastral setae covered with cerotegument, situated on distinct tubercles; seta *h*₂ longest (100 µm), other setae subequal in length (60–80 µm), all of them clearly visible in posterior view. Lyrifissures *im*, *ih*, *ip* and *ips* well developed, lyrifissure *ia* not evident; opisthosomal gland opening (*gla*) situated between *im* and *ip*.

Gnathosoma (Figs 1D, 2B, C): Subcapitular mentum wider than long, covered with cerotegument. Hypostomal setae *a*, *h* and *m* short (length 8–12 µm), spiniform, smooth. Chelicera with few blunt teeth on fixed and movable digits; Trägårdh's organ indistinct; setae *cha* and *chb* smooth. Palp slender, palpal setation: 0–2–1–3–9, including solenidion ω on tarsus.

Epimeral region (Fig. 1B–D): Tectum of podocephalic fossa strongly developed, laterally forming a strong, sharp tooth (*t*) directed underneath trochanter I. Parastigmatic tubercle *Sp* well developed, its tip rounded, not projecting laterally. Apodemes *apo.1*, *apo.2* and *apo.sj* distinctly developed, other apodemes not evident. Discidium conspicuously projecting laterally. Epimeral setal formula: 3–1–3–3, most setae very short (length 5–8 µm), spiniform to attenuate, smooth, only setae *3c* and *4c* long (length ~30 µm), much longer than others and covered with cerotegument.

Ano-genital region (Figs 1D, 2A, F): Genital and anal apertures distinctly separated from each other, anal aperture larger than genital one. Six or seven pairs of genital, one pair of aggenital, two pairs of anal and two pairs of adanal setae; genital and aggenital setae smooth; anal and adanal setae covered with cerotegument. Adanal lyrifissures very small, hardly visible, in paranal position, inserted at level slightly anterior to anal setae *an*₂.

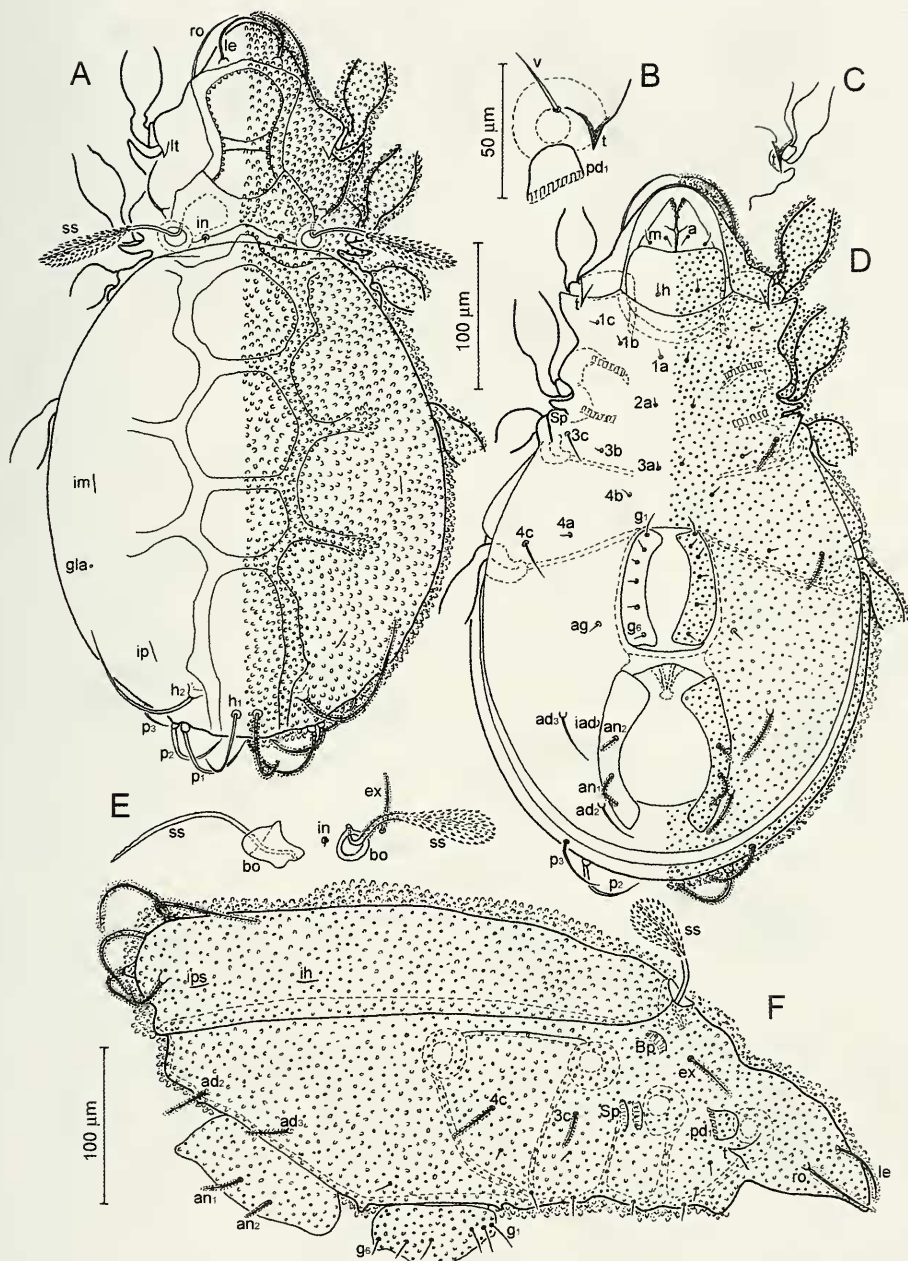


FIG. 1

Adult of *Gymnodamaeus meyeri* sp. n. (A) Dorsal view of body. (B) Lateral view of tectum of podocephalic fossa, together with pedotectum I and seta v on trochanter of leg I. (C) Ventral view of tectum of podocephalic fossa, together with pedotectum I and part of trochanter and femur I. (D) Ventral view of body. (E) Sensillus, after removal of cerotegument (left) and with cerotegument (right). (F) Lateral view of body. A, C-E to same scale.

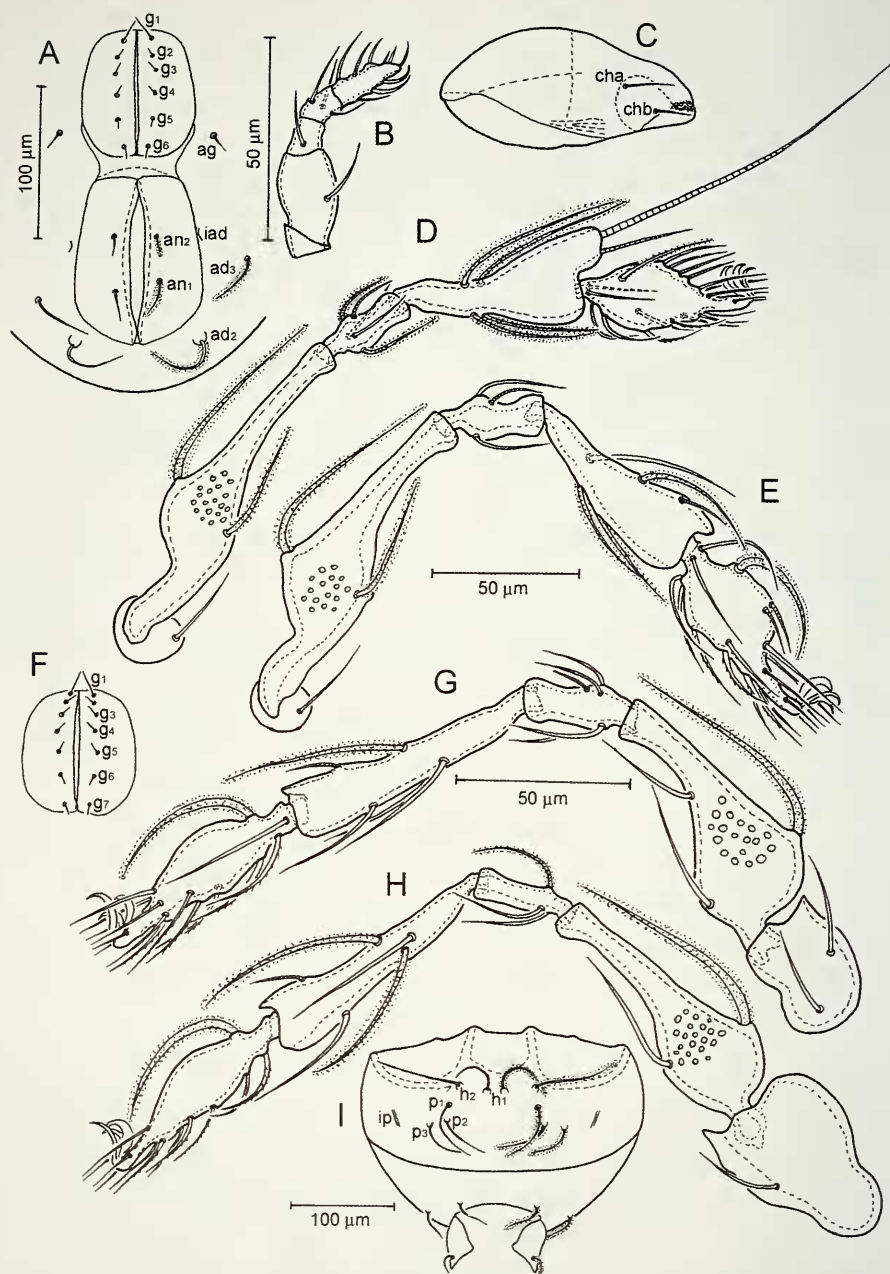


FIG. 2

Adult of *Gymnodamaeus meyeri* sp. n. (A) Ano-genital region. (B) Palp (right, antiaxial view). (C) Chelicera (right, antiaxial view). (D) Leg I. (E) Leg II. (F) Genital plates showing different numbers of genital setae. (G) Leg III (trochanter twisted). (H) Leg IV (all legs of right side, antiaxial view). (I) Posterior view of opisthosoma. A and F, B and C, D and E, G and F to same scale.

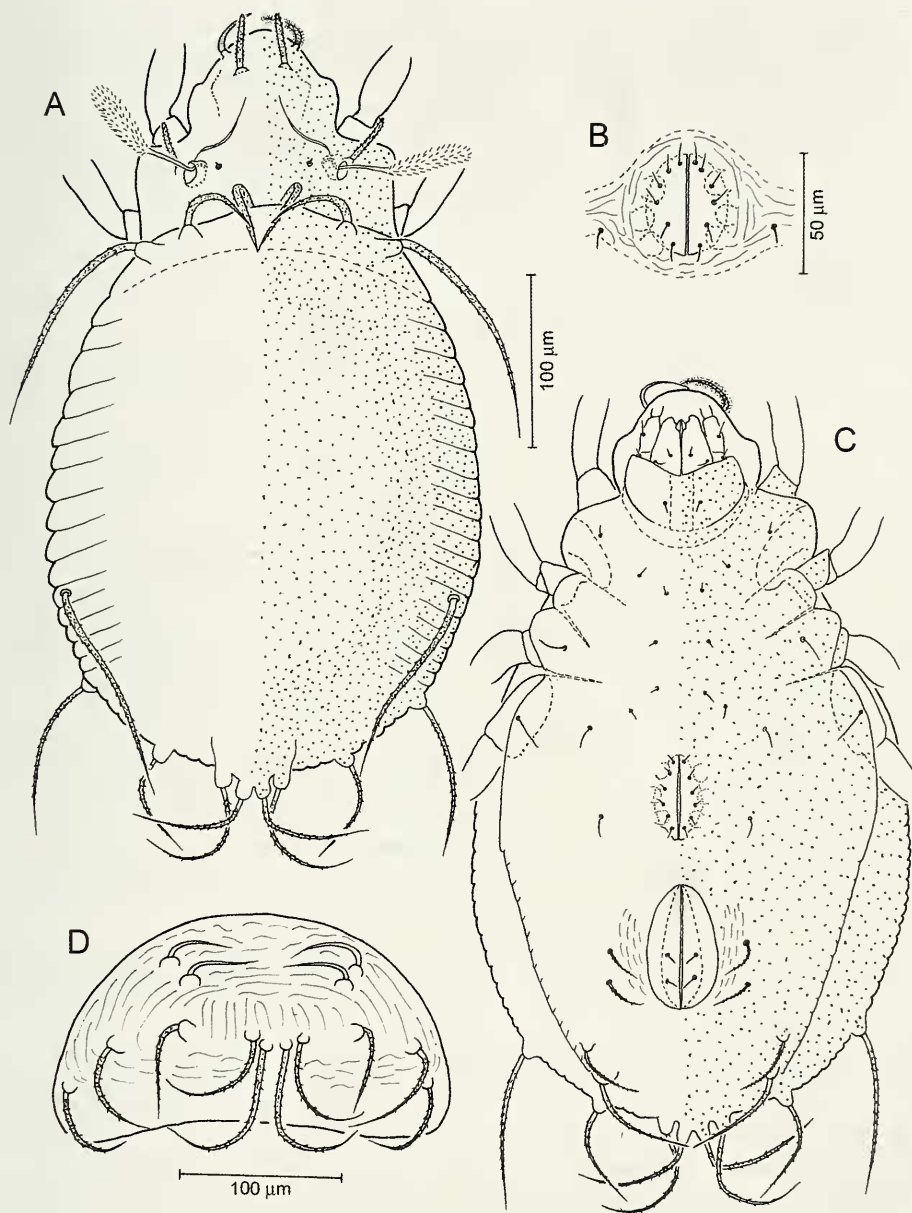


FIG. 3

Tritonymph of *Gymnodamaeus meyeri* sp. n. (A) Dorsal view of body. (B) Genital region. (C) Ventral view of body. (D) Posterior view of opisthosoma. A and C to same scale.

Legs (Fig. 2D, E, G, H): Articulations of leg segments normal, not in sockets. Ventro-distal tectum strongly developed on trochanters III and IV. All tibiae with strong dorso-distal projections. Solenidia σ on genua I, II and III inserted not adjacent

to setae *d* but conspicuously separated, distinctly shorter than corresponding setae *d*. Solenidion φ_1 of tibia I very long (length 120 μm), φ_2 short, both solenidia inserted on very large dorso-distal projection; solenidia φ of tibiae II, III and IV subequal in length. Some setae of femora, genua, tibiae and tarsi covered with dense cerotegument, setae of all trochanters smooth. Formula of leg setation (including famulus): I (1-2-4-4-19); II (1-2-2-4-17); III (2-3-4-4-15); IV (1-2-3-4-12); formula of solenidia: I (1-2-2); II (1-1-2); III (1-1-0); IV (0-1-0).

DESCRIPTION OF TRITONYMPH

Measurements (n=5): Body length 365-410 (382) μm ; length of notogaster 274-319 (288) μm ; width of notogaster 198-258 (220) μm .

Integument: Body color light yellowish. Body and leg segments covered with thin cerotegument consisting of small round granules. Anal region, lateral and posterior plates of hysterosoma with faint striations.

Prodorsum (Fig. 3A): Rostrum rounded in dorsal view, distinctly projecting antero-ventrad in lateral view. Rostral seta moderately thick and long, covered with cerotegument, inserted on dorso-lateral side of prodorsum. Lamellar seta nearly as long as *ro*, with minute barbs, inserted dorsally on prodorsum. Interlamellar seta minute, only observable in dorsal view. Exobothridial seta as long as setae *ro*, minutely barbed. Sensillus with long stalk and densely barbed, dilated head. Bothridium relatively small, irregularly funnel-shaped, directed postero-laterad. A pair of faint, obliquely oriented exobothridial ridge-like structures situated antero-medially of each bothridium.

Gastronotic region (Figs 3A, C, D, 4A): Oval, about 1.3 times as long as wide; anterior margin rounded, lateral and posterior margins undulated. Ten pairs of barbed notogastral setae; setae *c*₁, *c*₂, *c*₃ long, thick, among them *c*₃ longest, situated along anterior margin of notogaster; setae *p*₁, *h*₁, *h*₂, *h*₃ located along posterior margin of notogaster; setae *lp* situated dorso-laterally on notogaster, anterior to *h*₃; setae *p*₂ and *p*₃ situated ventrally. Some tritonymphs carrying exuviae, possessing a number of setae on each molting layer (Fig. 4B).

Gnathosoma (Fig. 3C): Subcapitular mentum much wider than long, without microtubercles. Hypostomal setae *h*, *a* and *m* short, thin, smooth. Details of chelicera and palp not studied.

Epimeral region (Fig. 3C): Apodemes poorly developed, only *apo.2*, *apo.sj* and *apo.3* observable. Epimeral setae thin, smooth; epimeral setal formula: 3-1-2-3.

Ano-genital region (Figs 3B, C, 4C): Anal aperture much larger than genital one; genital plates incompletely developed; genital papillae subequal in size; six pairs of genital, one pair of aggenital setae present (Fig. 3B). Anal plates complete, weakly sclerotized, two pairs of anal setae thin, smooth, two pairs of adanal setae long, barbed. Anal aperture surrounded by faint striae or wrinkles (Fig. 4C).

Legs (Fig. 5): Monodactylous, covered with round granules. Tibia I with strong dorso-distal projection (Fig. 5B); trochanters II, III and IV with less developed dorso-distal projection, other leg segments without distinct projections. Most leg setae, except for some setae on tarsi, tibiae and genua, long, thick and conspicuously barbed. Formula of leg setation: I (1-4-4-4-15); II (1-3-3-5-16); III (2-3-3-4-13); IV (1-2-3-3-10); formula of solenidia: I (1-1-2); II (1-1-2); III (1-1-0); IV (0-1-0).

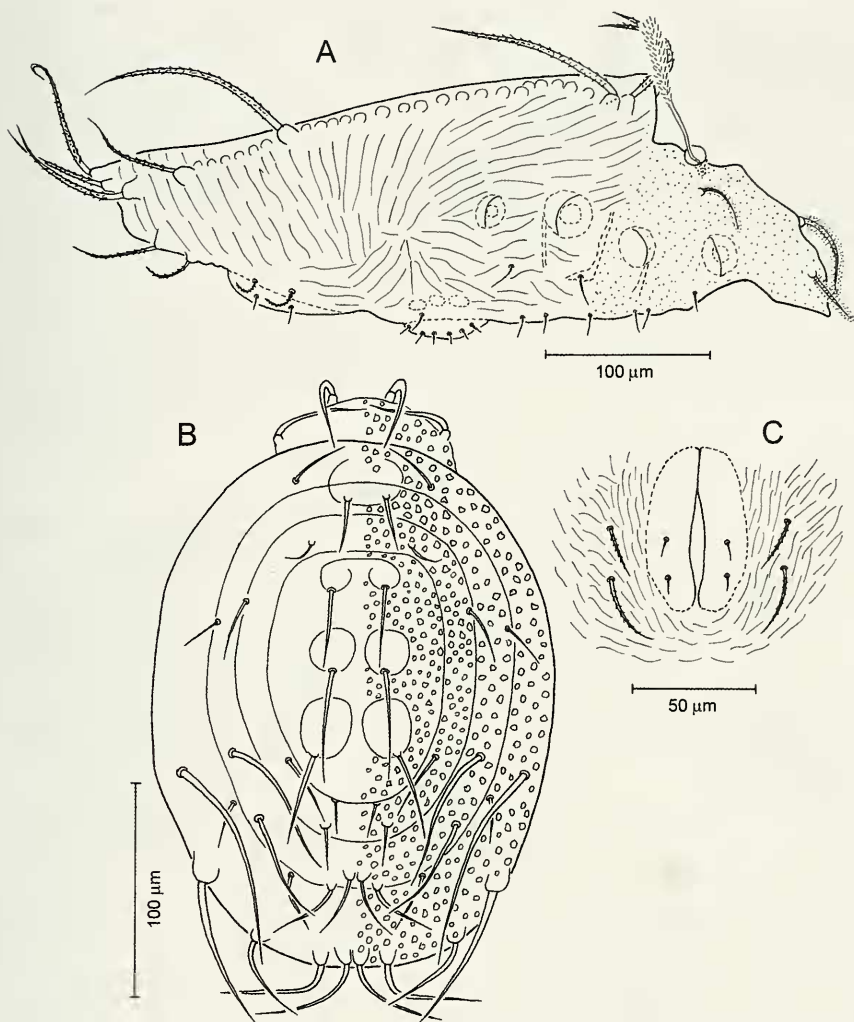


FIG. 4

Tritonymph of *Gymnodamaeus meyeri* sp. n. (A) Lateral view of body. (B) Dorsal view of exuviae. (C) Anal region.

REMARKS: Adult specimens of *Gymnodamaeus meyeri* sp. nov. are easily distinguishable from other known species of *Gymnodamaeus* by the characteristic pattern of dorsal ridge-like structures on prodorsum and notogaster, by the presence of a well-developed tectum of the podocephalic fossa, laterally developed as a strong, sharp tooth underneath trochanter I, and by the presence of a posteriad-directed tooth on the dorsal end of the acetabular tectum I. None of the other known species of *Gymnodamaeus* show this type of tectum or tooth.

The new species resembles the North American species, *G. gildersleeveae* Hammer, 1952, in having similar dorsal ridge-like structures on the notogaster.

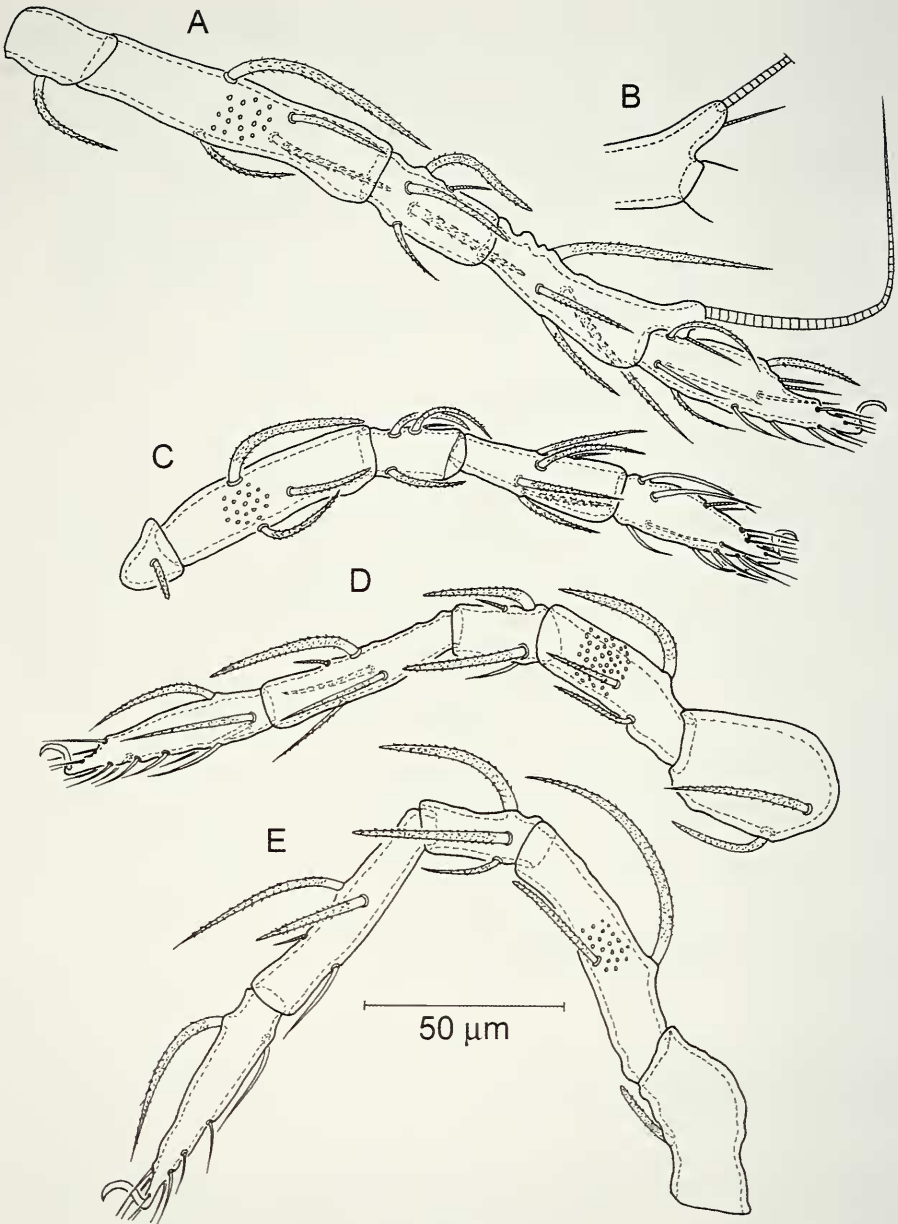


FIG. 5

Tritonymph of *Gymnodamaeus meyeri* sp. n. (A) Leg I. (B) Distal part of tibia I. (C) Leg II. (D) Leg III. (E) Leg IV (all legs of right side, antiaxial view). All figures to same scale.

However, *G. gildersleeveae* differs in the position of its longitudinal and transversal ridge-like structures on the notogaster and by the interspace between them; by the presence of a complete interlamellar ridge-like structure; by the presence of only three

pairs of notogastral setae and by the different position of the notogastral seta p_1 (in *G. gildersleeveae* seta p_1 in a median or central position close to h_1 , but in *G. meyeri* sp. n. seta p_1 in a lateral position close to p_2). The characteristics of the ventral and lateral aspects of the body of *G. gildersleeveae* were not described in detail or illustrated by Hammer (1952), therefore any further comparison is impossible.

ETYMOLOGY: This species is dedicated to our friend and colleague, Dr Erwin Meyer, Department of Terrestrial Taxonomy and Ecology, Institute of Ecology, Leopold-Franzens University of Innsbruck, Austria, who generously encouraged our collaborative work.

ECOLOGY: This species was found in an open forest of *Pinus sylvestris*, with *Juniperus communis* as undergrowth. The samples were taken in grass and pine litter and in dry moss. The few records at the type locality indicate a preference for arid habitats.

DISTRIBUTION: Currently this species is known only from the type locality.

Gymnodamaeus irregularis sp. n.

Figs 6-9

MATERIAL EXAMINED: Holotype (♀): Austria, Tyrol, Mötz, Birgele (a small hill west of the village of Mötz), arid grassland in clearing on summit, 660 m a.s.l., 25 April 2007, leg. H. Schatz; three paratypes (1♂ and 2♀) with same data as for holotype; two paratypes (1♂ and 1♀), *ibid.*, collected on 2 September 2006, leg. H. Schatz; deutonymph (one specimen) with same data as for holotype.

TYPE DEPOSITORY: The alcohol-preserved adult holotype and one adult paratype will be deposited in the Muséum d'histoire naturelle, Genève, Switzerland, other specimens in the authors' collections.

DIAGNOSIS: Adults of this species are unique among the known species of *Gymnodamaeus* in the combination of following character states: Body size relatively small, surface, sensillus and legs covered with thick cerotegument consisting of round to conical granules; rostral seta inserted ventro-laterally, lamellar seta inserted dorso-laterally, slightly anterior to rostral seta; sensillus long, thin, distal part dilated, covered with dense cerotegument; prodorsum with a pair of thick longitudinal ridge-like structures connected by two transversal ridges; notogaster with two pairs of irregular longitudinal ridge-like structures; five pairs of notogastral setae covered with cerotegument, inserted on distinct tubercles; seven pairs of genital and two pairs of adanal setae present; seta ad_1 absent; a pair of strongly developed tubercles Sp present on epimeral region III.

DESCRIPTION OF ADULT

Measurements: Holotype: Body length 353 µm, length of notogaster 255 µm, width of notogaster 198 µm. Paratypes (n=5): Body length 346-388 (355) µm, length of notogaster 237-281 (260) µm, width of notogaster 194-228 (206) µm.

Integument: Color yellowish brown. Body surface, sensilli and leg segments covered with thick cerotegument consisting of round to conical granules. Surface smooth after removal of cerotegument. Exuvial scalps absent.

Prodorsum (Fig. 6A, C, D): Rostrum broadly rounded in dorsal view, slightly projecting in lateral view. Rostral seta moderately long, covered with cerotegument,

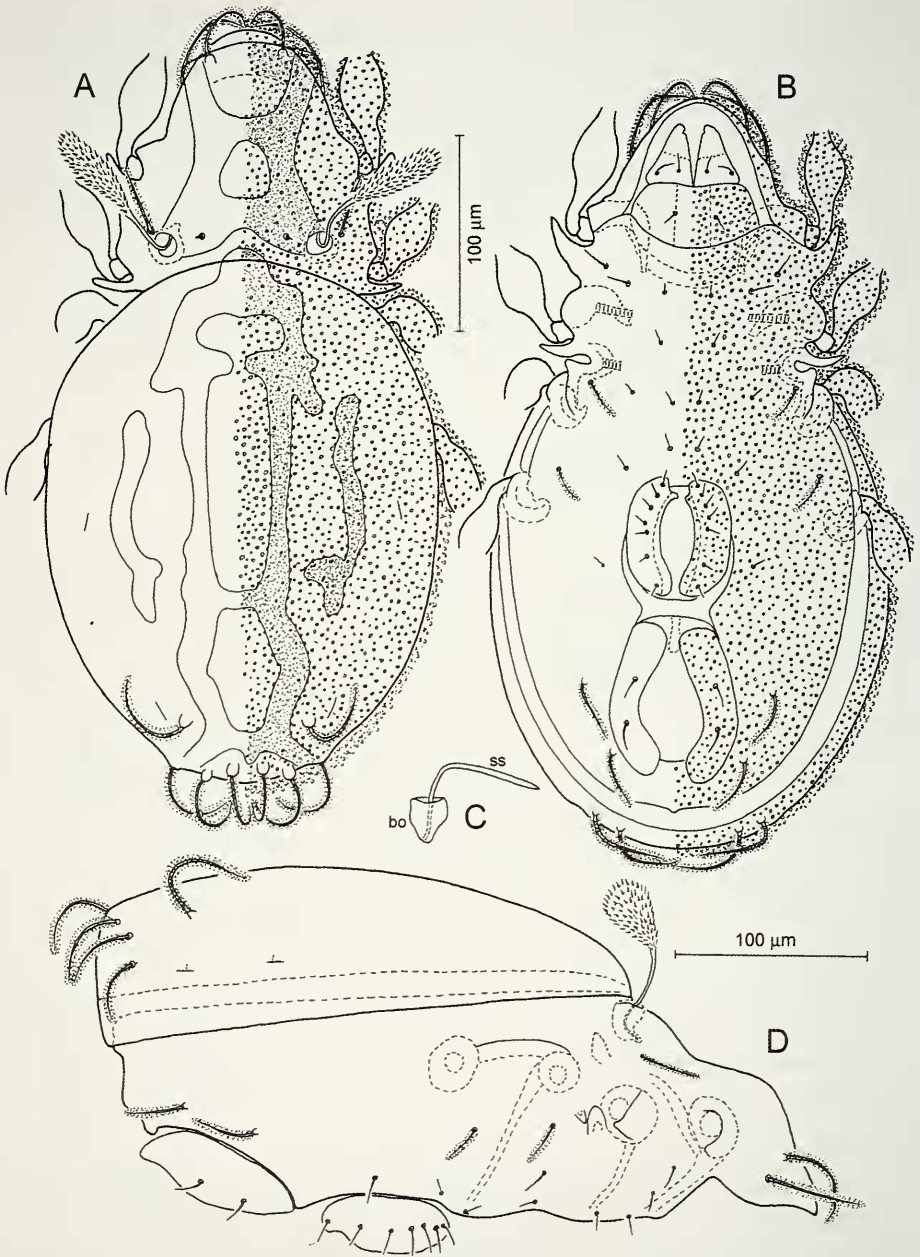


FIG. 6

Adult of *Gymnodamaeus irregularis* sp. n. (A) Dorsal view of body. (B) Ventral view of body. (C) Sensillus after removal of cerotegument. (D) Lateral view of body. A-C to same scale.

inserted ventro-laterally on prodorsum. Lamellar seta nearly as long as *ro*, covered with cerotegument, inserted dorso-laterally, slightly anterior to *ro*. Interlamellar seta minute but well observable in dorsal view. Exobothridial seta shorter than *le*, covered with cerotegument. Sensillus long, thin, its distal part dilated, covered with dense cerotegument. Sensillus bacilliform after removal of cerotegument (Fig. 6C, D). Bothridium irregularly funnel-shaped, with large openings. A pair of longitudinal ridge-like structures (*apo ex*) present anterior to each bothridium, leading to insertions of rostral setae. Rostral ridge-like structure (*apo ro*) strongly convex, situated anterior to insertions of lamellar setae; bothridial ridges (*apo bo*) well developed, situated between bothridia and connected to each other between interlamellar setae. Central ridge-like structure (*apo c*) of prodorsum nearly conical or oval in shape, situated antero-medially of interlamellar seta.

Notogaster (Figs 6A, D, 7A): Oval, about 1.3 times as long as wide, very flat in lateral view and conspicuously flattened anteriorly; anterior notogastral margin broadly rounded. Ridge-like structures on notogaster formed by cerotegument, with two pairs of irregular longitudinal bands, median pair interconnected by short transverse bands in posterior half of notogaster; anterior and posterior ends of median bands connected, posterior end bifurcated. Lateral pair relatively short, situated in median part of notogaster. Shape, size and position of these longitudinal ridges variable. Five pairs of notogastral setae, sub-equal in length (35–55 μm), covered with cerotegument, situated on distinct tubercles, all of them clearly visible in posterior view. Lyrifissures *im*, *ih*, *ip* and *ips* well developed, lyrifissure *ia* not evident; opisthosomal gland opening situated at mid-level between *im* and *ip*.

Gnathosoma (Fig. 6B): Subcapitular mentum wider than long, covered with cerotegument. Hypostomal setae *a*, *h* and *m* short (7–11 μm), spiniform, smooth. Chelicera and palp as in previous species.

Epimeral region (Fig. 6B, D): Parastigmatic tubercle *Sp* well developed, projecting laterally. Apodemes *apo.1*, *apo.2* and *apo.sj* well developed, other apodemes not evident. Discidium well developed, but not projecting laterally. Epimeral setal formula 3-1-3-3, most setae distally attenuating, short (length 5–8 μm), smooth, setae *3c* and *4c* much longer than others (length 15–20 μm) and covered with cerotegument.

Ano-genital region (Fig. 6B, D): Genital and anal apertures well separated from each other, anal aperture larger than genital one. Seven pairs of genital, one pair of aggenital, two pairs of anal and two pairs of adanal setae present; genital, aggenital and anal setae short, smooth; adanal setae long, covered with cerotegument. Adanal lyrifissure not evident.

Legs (Fig. 7B–E): Articulations of leg segments normal, not in sockets. Ventro-distal tectum strongly developed on trochanters III and IV. Tibia I with strong, tibia II with small dorso-distal projections. Solenidia σ on genua I, II and III inserted at some distance from setae *d*, and conspicuously shorter than corresponding setae *d*. Solenidion φ_1 of tibia I very long (length $\sim 90 \mu\text{m}$), φ_2 short, both solenidia inserted on large dorso-distal projection. Solenidia φ of tibiae II, III and IV subequal in length. Some setae of femora, genua, tibiae and tarsi covered with dense cerotegument, setae of all trochanters smooth, except for setae *v* on trochanter III. Formula of leg setation

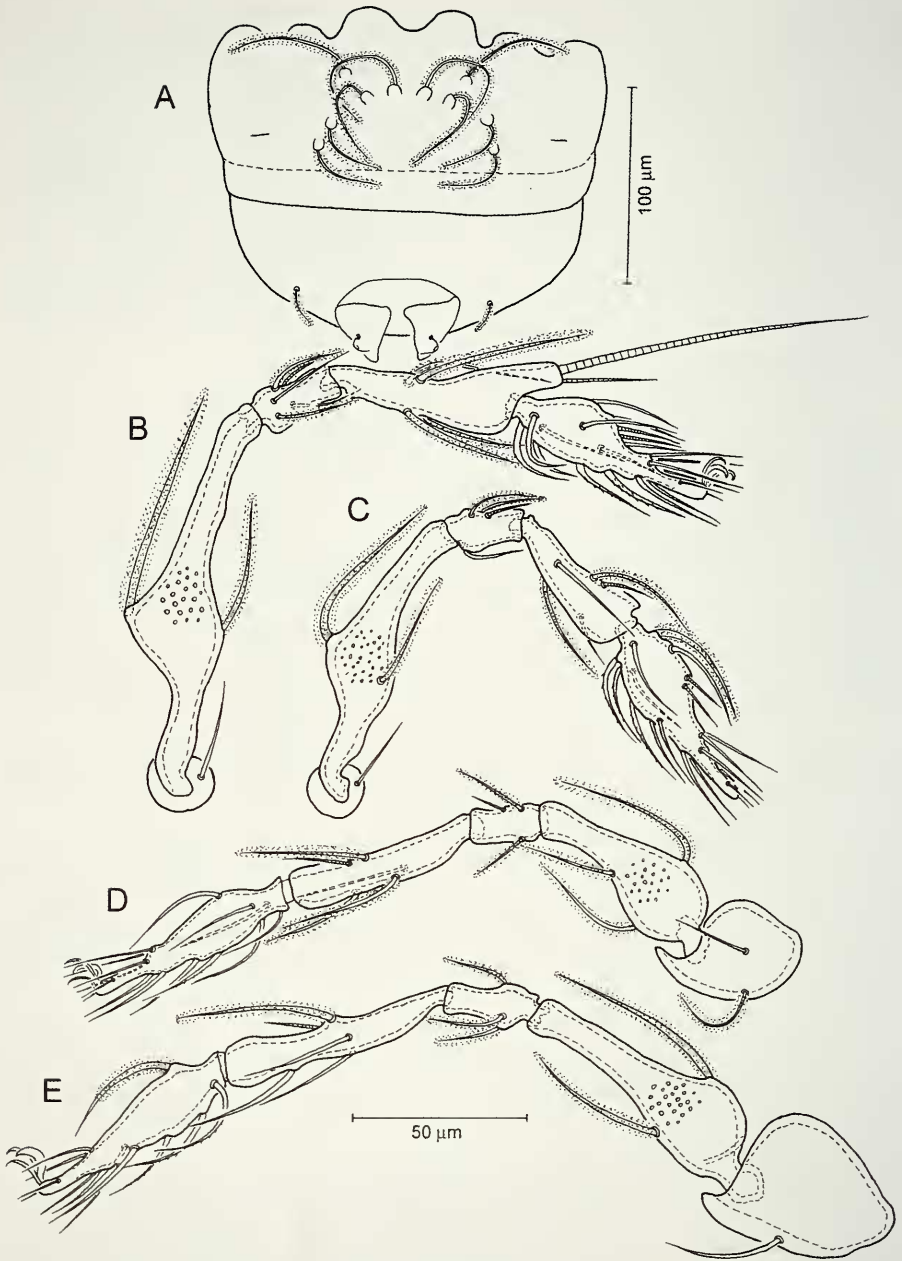


FIG. 7

Adult of *Gymnodamaeus irregularis* sp. n. (A) Posterior view of opisthosoma. (B) Leg I. (C) Leg II. (D) Leg III. (E) Leg IV (all legs of right side, antiaxial view). B-E to same scale.

(including famulus): I (1-2-4-4-19); II (1-2-3-4-17); III (2-3-2-3-15); IV (1-2-3-4-12); formula of solenidia: I (1-2-2); II (1-1-2); III (1-1-0); IV (0-1-0).

DESCRIPTION OF DEUTONYMPH

Measurements (n=1): Body length 277 μ m; length of notogaster 194 μ m; width of notogaster 156 μ m.

Integument: Body color light yellowish. Body and leg segments covered with thin cerotegument consisting of small round granules. Notogaster with exuvial scalps, covered with minute granular reticulations of different shapes and sizes. Ventral, lateral and posterior plates of hysterosoma with faint striae or wrinkles.

Prodorsum (Fig. 8A, C): Rostrum rounded in dorsal view (Fig. 8A), relatively robust in lateral view (Fig. 8C). Rostral seta moderately thick and long, with minute dense barbs, inserted on lateral side of prodorsum. Lamellar seta slightly longer than *ro*, densely barbed, inserted dorsally on prodorsum. Interlamellar seta minute, but well observable in dorsal view. Exobothridial seta as long as setae *ro*, minutely barbed. Sensillus with long stalk and densely barbed club-shaped head. Bothridium relatively small, irregularly funnel-shaped, directed postero-laterad. Exobothridial ridge-like structures incompletely developed, situated anterior of interlamellar setae. A pair of ridge-like longitudinal structures present laterally, close to insertion tubercles of lamellar setae.

Gastronotic region (Figs 8A, C, 9E): Oval, about 1.2 times as long as wide; with exuvial scalps, covered with minutely granular reticulations of different shapes and sizes. Anterior and posterior margins with large tubercular insertions of notogastral setae; lateral margins undulated. Ten pairs of notogastral setae long, thick, barbed, among them *c*₃ longest, situated close to anterior margin of notogaster.

Gnathosoma (Fig. 8B): Subcapitular mentum wider than long, without micro-tubercles. Hypostomal setae *h*, *a* and *m* short, thin, smooth. Details of chelicera and palp not studied.

Epimeral region (Fig. 8B): Apodemes poorly developed, only *apo.2*, *apo.sj* and *apo.3* faintly visible. Epimeral setal formula: 3-1-2-0, setae thin, smooth.

Ano-genital region (Fig. 8B): Anal aperture much larger than genital one; genital and anal plates incompletely developed; genital papillae sub-equal in size; four pairs of genital, one pair of aggenital setae present; anal and adanal setae absent.

Legs (Fig. 9A-D): Monodactylous, covered with round granules. Tibia I with strong dorso-distal projection, other leg segments without projection. Most leg setae, except some setae on tarsi, tibiae and genua long, thick, conspicuously barbed. Formula of leg setation: I (1-3-3-4-15); II (0-3-3-4-12); III (1-3-2-4-11); IV (0-1-1-2-11); formula of solenidia: I (1-1-1); II (1-0-0); III (0-1-0); IV (0-0-0).

REMARKS: Adult specimens of *Gymnodamaeus irregularis* sp. n. are easily distinguishable from those of other known species of *Gymnodamaeus* by the shape of the dorsal ridge-like structures on prodorsum and notogaster, by the strongly developed parastigmatic tubercles *Sp* in the epimeral region, and by the smaller body size.

The new species generally resembles *G. helveticus* Woas, 1992, described from Grisons, Switzerland. That species differs from *G. irregularis* sp. n. in the absence of ridge-like structures on the notogaster, in the position of notogastral setae *p*₁ which are

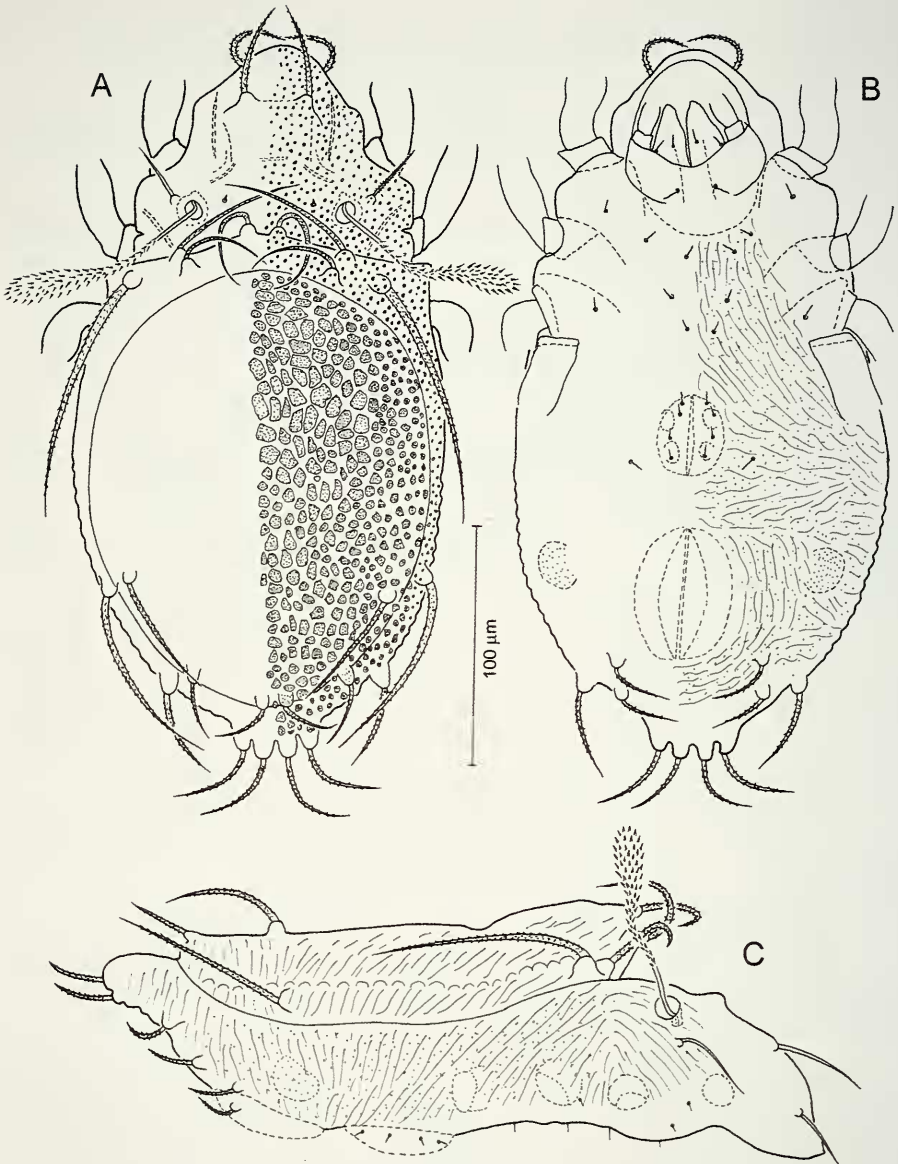


FIG. 8

Deutonymph of *Gymnodamaeus irregularis* sp. n. (A) Dorsal view of body with exuviae. (B) Ventral view of body. (C) Lateral view of body with exuviae. All figures to same scale.

situated more laterally (p_1 situated very close to p_2 in *G. irregularis* sp. n.); in longer anal setae an_1 covered with cerotegument, which are more than twice as long as those in *G. irregularis* sp. n.; in the presence of strongly developed tubercles (S2 according to Woas, 1992) under the acetabula of leg III, and in a far larger body size (470 μm in length, 240 μm in width).

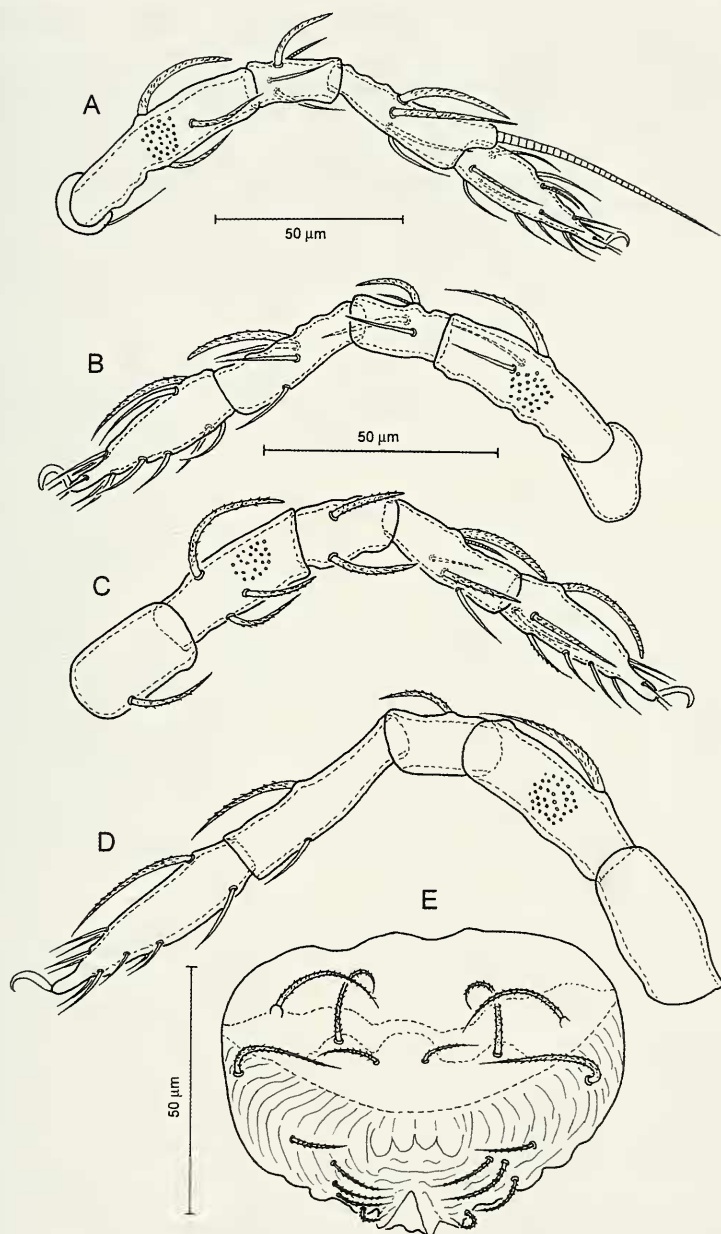


FIG. 9

Deutonymph of *Gymnodamaeus irregularis* sp. n. (A) Leg I (right side, antiaxial view). (B) Leg II (left side, antiaxial view). (C) Leg III (right side, antiaxial view). (D) Leg IV (right side, antiaxial view). (E) Posterior view of opisthosoma. B-D to same scale.

ETYMOLOGY: The species name “*irregularis*” refers to the irregular ridge-like structure on the notogaster.

ECOLOGY: The small hill “Birgele” or “Bürgele” west of Mötz contains one of the last relicts of xerothermic oak and bush vegetation in the Inn valley. This type of vegetation used to be more widespread before the spread of intensive cultivation. The new species was found in a small clearing with arid grassland near the summit of the hill. The samples were taken in dry grass, roots and humus. The few records, all from the type locality, indicate a preference of this species for arid habitats.

DISTRIBUTION: Currently this species is known only from the type locality.

DISCUSSION

As mentioned above, we consider the genus *Gymnodamaeus* in a broad sense. However, we do not accept all synonyms proposed by Woas (1992), because we accept the validity of the following genera: *Jacotella* Banks, 1947, *Plesiodamaeus* Grandjean, 1954 and *Adrodamaeus* Paschoal, 1982.

The first two genera have well-developed prominent folds on the posterior edge of the notogaster bearing long setae h_1 or p_1 , and the other notogastral setae are minute or absent. The leg segment articulations of *Adrodamaeus* are in sockets, which is not the case in *Gymnodamaeus*. Therefore, we consider these genera as valid taxa.

The placement of other genera, *Joshuella* Wallwork, 1972, *Odontodamaeus* Paschoal, 1982, *Nortonella* Paschoal, 1982, *Johnstonella* Paschoal, 1982, in the synonymy of *Gymnodamaeus* as proposed by Woas (1992) are accepted by us. Most of these synonyms were also accepted by Subías (2004, 2008) and he additionally listed *Pleodamaeus* Paschoal, 1983 as a junior synonym of *Gymnodamaeus*. However, Subías considers *Nortonella* and *Joshuella* as valid genera, and proposed a replacement name, *Nortella*, for the first genus because *Nortonella* is a junior homonym of a hymenopteran genus. We compared the features of the known species of these two genera, but did not find any apomorphic characters distinguishing them from *Gymnodamaeus*.

Concerning the species diversity of *Gymnodamaeus*, Paschoal (1982) assigned 13 species to this genus, including 9 spp. described by him, but considered five previously known species as *species inquirendae*. However, most of his newly described species, such as *G. gregarius*, *G. knowltoni*, *G. notoapodematus*, *G. saltuensis*, *G. taedaceus*, *G. umbraticus*, *G. victoriae* should also be regarded as *species inquirendae*, since there are no illustrations and the available descriptions are not suitable for reconstruction of the species characters.

Woas (1992) described or redescribed two species (*G. bicostatus* and *G. helveticus*) and listed 10 additional species, which he included in *Gymnodamaeus*. However, in our opinion, several of these are obviously not members of this genus, as *G. hispanicus* (Grandjean, 1928), *G. craterifer* (Haller, 1884), *G. glaber* (Mihelčič, 1957) and *G. tuberculatus* (Aoki & Fujikawa, 1971). The first species is a typical member of *Arthrodamaeus*, while the second and third species are members of *Plesiodamaeus*, and the latter species is a representative of *Allodamaeus*.

Subías (2004, 2008) listed 25 species under *Gymnodamaeus*. He transferred *Arthrodamaeus mongolicus* Bayartogtokh & Weigmann, 2005 to this genus without

giving any reason. This species shows the articulation of legs in sockets, which is not characteristic for *Gymnodamaeus*.

At present, there are 36 known species of *Gymnodamaeus*, including the two described here. Representatives of this genus seem to be relatively rare. Almost all known species were described from the Holarctic region. The geographical distribution of *Gymnodamaeus* includes Europe, Central and East Asia, and North America. According to the present data, only the type species, *G. bicostatus* is distributed over the whole Holarctic region. Most of the other species seem to be confined to small areas or are known from the type localities only.

Apart from the common species, *G. bicostatus*, some 21 species are recorded from North America. The fauna of Canada involves six species (*G. bicostatus*, *G. gildersleeveae* Hammer, 1952, *G. ornatus* Hammer, 1952, *G. saltuensis* Paschoal, 1982, *G. taedaceus* Paschoal, 1982 and *G. victoriae* Paschoal, 1982). On the other hand, the fauna of the USA shows a greater diversity, including 18 species (*G. agrosticulus* (Paschoal, 1983), *G. bicentenaria* (Paschoal, 1983), *G. bicostatus*, *G. chalazionus* Woolley, 1972, *G. gildersleeveae*, *G. gregarius* Paschoal, 1982, *G. guilfordidei* Paschoal, 1982, *G. knowltoni* Paschoal, 1982, *G. leurolomasus* Woolley & Higgins, 1973, *G. notoapodematus* Paschoal, 1982, *G. orbicularius* Paschoal, 1982, *G. pearsei* Banks, 1947, *G. plokosus* Woolley & Higgins, 1973, *G. striatus* Wallwork, 1972 (also recorded from Sonora, Mexico), *G. subalpinus* (Paschoal, 1983), *G. theliis* Woolley & Higgins, 1973, *G. umbraticus* Paschoal, 1982, *G. veriornatus* Higgins, 1961).

Europe contains seven known species, but except for *G. bicostatus* most of them have restricted distributions. Thus, four species (*G. barbarossa* Weigmann, 2006, *G. helveticus* Woas, 1992, *G. meyeri* sp. n. and *G. irregularis* sp. n.) are found in Central Europe, one species, *G. quadriseta* Ruiz, Kahwash & Subías, 1990 is recorded from Southern Europe (Mediterranean region), and a single species, *G. tuberculatus* (Bayartogtokh & Smelyansky, 2004) is described from Eastern Europe (European part of Russia).

As for Asia, there are eight species, but again *G. bicostatus* is the most widely distributed species in the vast areas of Siberia, Russian Far East, Kazakhstan and Mongolia. Two species, *G. polygrammus* (Wen & Chen, 1992) and *G. tectoria* (Wen & Chen, 1992) have been described from the south and south-eastern parts of China. Two other species, *G. mongolicus* (Bayartogtokh & Aoki, 1997) and *G. rotundigranulatus* (Bayartogtokh, 2001) are known from Mongolia, but the first species is also recorded from eastern Kazakhstan and southern Russia. Two more species, *G. addpressus* (Aoki & Fujikawa, 1971) and *G. transitus* (Aoki, 1984) are found in Japan. Only a single species, *G. kazakhstanicus* (Bayartogtokh & Smelyansky, 2002) has been described from Kazakhstan.

Most species of this genus occur in various types of forests, as inhabitants of litter, mosses, decaying wood, as well as of the upper soil layer of open habitats, such as mountain steppe, lowland steppe, meadows etc. Since the genus is still incompletely investigated in many areas of the world, further species certainly remain to be discovered.

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